



Landscape Pattern Metrics at Fort Benning, Georgia

by Mark R. Graves, Scott G. Bourne

INTRODUCTION: The Department of Defense (DoD) has established ecosystem management as its approach to management of military lands. The Strategic Environmental Research and Development Program (SERDP) Ecosystem Management Program (SEMP) was established in December 1997 to help address critical deficiencies in knowledge which prohibit the DoD from fully achieving this goal (Kress 2001). One component of the SEM is the Ecosystem Characterization and Monitoring Initiative (ECMI). The objectives of the ECMI, described in Kress (2001), include the development and implementation of monitoring and characterization activities that can support the assessment of relationships between land use and management, and ecosystem structure, function, and pattern. Fort Benning, Georgia, was established as the first test site for implementation of the objectives of the SEM.

Understanding a landscape requires adequately defining the physical characteristics of the terrain (topographic parameters such as elevation, slope, aspect; geology and soil composition; hydrology, etc.); the processes acting on that terrain (meteorology, human activity, etc.); and the composition of the landscape (land cover). However, it is not enough to simply characterize the variety and amounts of land cover types that exist in a landscape. Characterizing the structure or pattern of the occurrences of the individual land cover types (and how they are interspersed) in the landscape is also important. Over the past few years the examination of landscape patterns (also called landscape ecology) has resulted in the development of a large suite of metrics to define landscape patterns and structure. This paper presents calculations of landscape metrics for the Fort Benning study area.

STUDY SITE DESCRIPTION: Fort Benning is located in west-central Georgia south of the city of Columbus, Georgia. It occupies approximately 73,533 hectares (ha) in Chattahoochee, Muscogee, and Marion Counties in Georgia, and Russell County in Alabama. The base lies within the humid temperate domain, subtropical division, coniferous-broadleaved semi-evergreen forest province, as defined by Bailey (1995). Fort Benning falls within the southeastern plains ecoregion as defined by Omernik (1987). The base is located within hydrologic unit 03130003, as defined by the U.S. Geological Survey (USGS) (Figure 1).

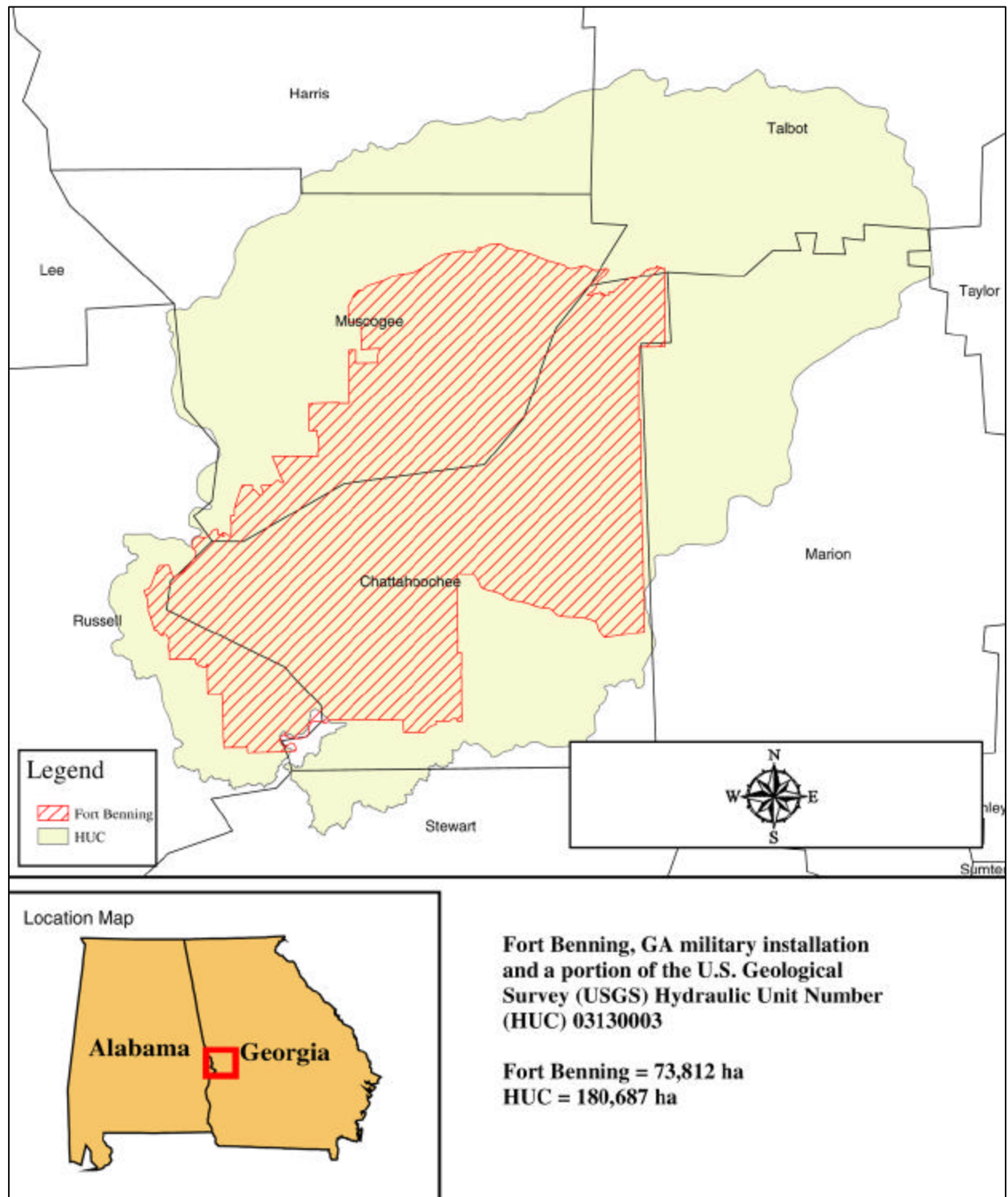


Figure 1. Study area

OVERVIEW OF LANDSCAPE METRICS: Landscape metrics are computed to describe patch, class, or landscape features. A “patch” is defined as each individual occurrence of a particular land cover type in the landscape. A “class” refers to all the occurrences of a particular cover type in the landscape. Metrics are computed and reported in terms of individual patches, by class, or for the landscape as a whole.

There are eight basic categories of metrics that can be computed (Table 1).

Table 1 Categories of Metrics	
Category	Description
Area/density	Indices related to the number and size of class patches, and the amount of edge created by these patches
Shape	Indices based directly on the shape of patches
Core area	Indices based on internal core areas of patches
Isolation/proximity	Metrics that measure relative isolation of class patches
Contrast metrics	Measure magnitude of difference between adjacent patch types
Contagion/interspersion	Metrics that measure landscape texture by examining the aggregation and intermixing of class patches
Connectivity	Metrics that attempt to measure the “structural connectedness” of patch types
Diversity	Indices related to the number of patches and their distribution throughout the landscape. Useful for assessing landscape structure

In this study, FRAGSTATS version 3.3 (McGarigal, Cushman, Neel, and Ene 2002), an updated Windows-based version of the original FRAGSTATS software developed by Oregon State University (McGarigal and Marks 1994), was used to compute landscape metrics.

A land cover classification based on 1999 Landsat ETM data ([Bourne and Graves 2001](#)) was used as the source data. As the original image classification included clouds and cloud shadow (representing approximately 1 percent of the study area), digital orthophotos from 1999 were displayed with the image classification results and, using on-screen digitizing techniques, the clouds and cloud shadows were replaced with valid classes.

Many of the metrics computed by FRAGSTATS require user input, such as defining a distance to be used for the computation of core area, or relative weights to be given to different class types. These decisions are usually driven by a specific application or topic of interest. For example, if a researcher wanted to examine the landscape composition as it impacts a certain avian species, the parameters assigned to define core area or weights assigned to relative worth of certain edge types might differ markedly from those assigned by another researcher looking at habitat from another perspective.

To get meaningful results from FRAGSTATS, it is necessary to have a good understanding both of the source data as well as the metrics that are calculated by the software. The purpose of this analysis was to look at landscape fragmentation from a descriptive perspective – without trying

to assign any meaning to the results. The results are presented for other researchers to use as they see fit. However, certain parameters had to be assigned. These are listed in the next section.

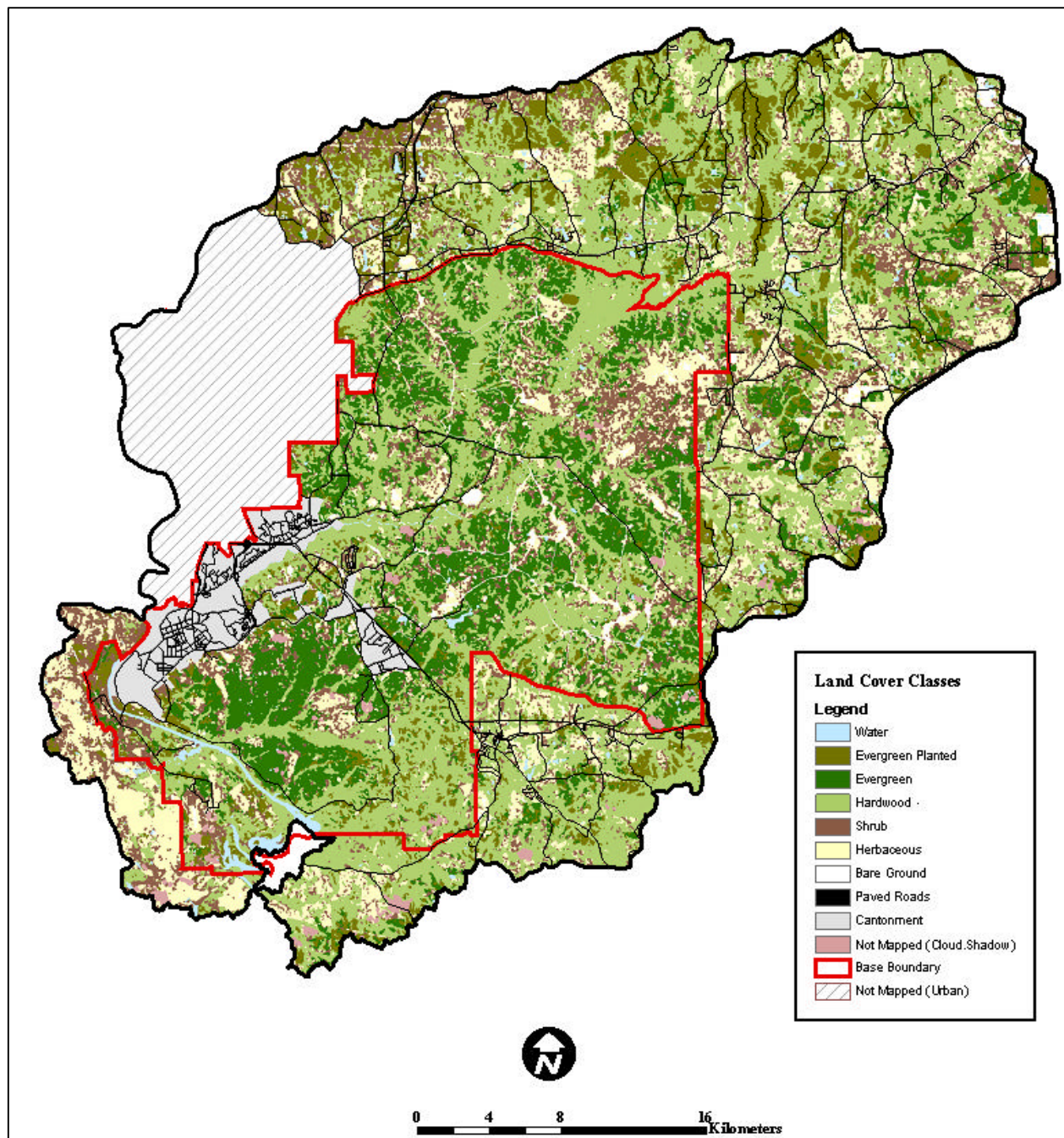


Figure 2. Land Cover from 1999 Landsat TM

For this study, metrics for each of the categories listed in Table 1 were computed, with the exception of contrast metrics. To compute contrast metrics, weights to be applied to different edge types must be defined. Since this type of weighting is, by nature, extremely subjective and driven by very specific applications of interest, contrast metrics were not included in this report.

In addition, metrics were only computed for the classes and the landscape as a whole. No patch metrics were computed.

SPECIFIED PARAMETERS AND CONDITIONS: To compute the metrics presented in this technical note, values had to be supplied to compute certain metrics (e.g. core area) and to define a search area to be used for proximity calculations. The following represent parameters used in calculating metrics:

Search area for isolation/proximity metrics: 100 meters

Edge depth for core area calculations: 100 meters

Fragmentation statistics were calculated for the Georgia side of HUC 03130003. The urban area representing Columbus, GA was masked out and was not included in the statistics calculations.

The metrics were calculated in two ways: with forest classes combined into one class, and with hardwood and evergreen classes separated. Statistics are not presented for road and contonment classes. Unlike the way urban areas were treated, these areas *were* included in the calculations, however. For this reason, percentage of landscape classes will not sum to 100. All distance metrics are reported in meters and area metrics are reported in hectares. The cell size of the input land cover classification is 27.5 m.

The metrics presented in this technical note are defined in Appendix A. Appendix B contains the metrics for combined forest classes, while metrics for separate evergreen/hardwood forest classes are presented in Appendix C. The metrics presented in Appendices B and C will be analyzed in detail during the next phase (FY03) of the ECMI.

DISCUSSION: This report provides initial landscape fragmentation metrics for the SEMP study area. The goal of this effort was to put descriptive statistics into the hands of researchers who may not have access to tools such as FRAGSTATS and to encourage discussion among the SEMP research community. It is hoped that such discussions might help guide more intense examination of landscape fragmentation metrics during the FY03 program.

During FY03, a second set of fragmentation metrics will be conducted for a 2001 Landsat ETM image of the study area. These metrics will be compared with the results from the 1999 ETM results. In addition, new image feature extraction software is being tested, which may allow for higher land cover classification accuracy than the conventional approach used for the 1999 imagery.

In this initial evaluation of fragmentation, urban classes were not included. The heterogeneous nature of urban areas creates many problems for the classification of satellite imagery, particularly coarse imagery such as that from Landsat TM. Since the cell size of the imagery is 28.5 m, many mixed-pixel classes are created in the clustering process. The presence of so many mixed-pixel classes in the clustering process can interfere with the definition of class statistics even in the landscape outside of the urban areas, resulting in a deterioration of the overall land cover classification accuracy. While texture information and low-pass filters can be used to help improve the classification accuracy of such areas, the accurate classification of urban area classes was not a goal of the 1999 Landsat classification effort and a decision was made to mask the

urban area to improve the classification process. During FY03, urban areas will be defined in more detail and landscape fragmentation will be examined more thoroughly.

ACKNOWLEDGEMENTS: This technical note was prepared for the Ecosystem Characterization and Monitoring Initiative (ECMI), sponsored by the Strategic Environmental Research and Development Program (SERDP), Ecosystem Management Project (SEMP). The technical monitor was Dr. Robert Holst, SERDP Program Manager.

The work was prepared under the direction of the Ecosystem Evaluation and Engineering Division (EE), U.S. Army Engineer Research and Development Center (ERDC). The EL Principal Investigator was Mr. Mark R. Graves and Co-Investigators were Mr. Scott G. Bourne, and Dr. David L. Price, EL. Project Manager for the ECMI is Mr. Harold W. West, EL, and Program Manager for the SEMP is Dr. Harold E. Balbach of the Construction Engineering Research Laboratory (CERL), ERDC, Champaign, IL.

Many individuals contributed to the support of this project including the following: Dr. Margaret R. Kress and Mr. Clarence Currie of EL; Mr. Pete Swiderek and Mr. John Brent of Fort Benning, Georgia, the host site for the SEMP; and Mr. Hugh Westbury, the host site coordinator for CERL.

At the time of the publication of this technical note, Director of EL was Dr. Edwin A. Theriot. Dr. James Houston was Director of ERDC, and COL John W. Morris III, EN, was Commander.

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This document should be cited as follows:

Graves, M. R., and Bourne, S. G. (2001). "Landscape pattern metrics at Fort Benning, Georgia," *SERDP Technical Notes Collection*, ERDC/EL TN-ECMI-02-2, U.S. Army Engineer Research and Development Center, Vicksburg, MS.
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Appendix A

Definition of Metrics

Area/Density/Edge Metrics:		
Type of Metric	Metric Abbrev.	Meaning
Class	CA	Core area
	PLAND	Percentage of landscape
	NP	Number of patches
	PD	Patch density
	TE	Total edge
	ED	Edge density
	LSI	Landscape shape index
	LPI	Largest patch index
	LSI	Landscape shape index
	nLSI	Normalized landscape shape index
	AREA_XX ¹	Patch area
	GYRATE_XX ¹	Radius of gyration distribution
Landscape	TA	Total area
	NP	Number of patches
	PD	Patch density
	TE	Total edge
	ED	Edge density
	LSI	Landscape shape index
	LPI	Largest patch index
	AREA_XX ¹	Patch area distribution below
	GYRATE_XX ¹	Radius of gyration distribution
Where XX = MN (Mean), AM (Area Weighted Mean), MD (Median), RA (Range), SD (Std. of Deviation, and CV (Coefficient of Variation).		

Shape Metrics:		
Type of Metric	Metric Abbrev.	Meaning
Class	SHAPE_XX ¹	Shape index distribution
	FRAC_XX ¹	Fractal index distribution
	PARA_XX ¹	Perimeter-area ratio distribution
	CIRCLE_XX ¹	Related circumscribing circle distribution
	CONTIG_XX ¹	Contiguity index distribution
	PAFRAC	Perimeter-area fractal dimension
Landscape	SHAPE_XX ¹	Shape index distribution
	FRAC_XX ¹	Fractal index distribution
	PARA_XX ¹	Perimeter-area ratio distribution
	CIRCLE_XX ¹	Related circumscribing circle distribution
	CONTIG_XX ¹	Contiguity index distribution
	PAFRAC	Perimeter-area fractal dimension
Where XX = MN (Mean), AM (Area Weighted Mean), MD (Median), RA (Range), SD (Std. of Deviation), and CV (Coefficient of Variation).		

Core Area Metrics:		
Type of Metric	Metric Abbrev.	Meaning
Class	TCA	Total core area
	CPLAND	Core area percentage of landscape
	NDCA	Number of disjunct core areas
	DCAD	Disjunct core area density
	CORE_XX ¹	Core area distribution
	DCORE_XX ¹	Disjunct core area distribution
	CAI_XX ¹	Core area index distribution
Landscape	TCA	Total core area
	NDCA	Number of disjunct core areas
	DCAD	Disjunct core area density
	CORE_XX ¹	Core area distribution
	DCORE_XX ¹	Disjunct core area distribution
	CAI_XX ¹	Core area index distribution
Where XX = MN (Mean), AM (Area Weighted Mean), MD (Median), RA (Range), SD (Std. of Deviation), and CV (Coefficient of Variation).		

Isolation/Proximity Metrics:		
Type of Metric	Metric Abbrev.	Meaning
Class	PROX_XX ¹	Proximity index
	ENN_XX ¹	Euclidean nearest neighbor distance
Landscape	PROX_XX ¹	Proximity index
	ENN_XX ¹	Euclidean nearest neighbor distance
Where XX = MN (Mean), AM (Area Weighted Mean), MD (Median), RA (Range), SD (Std. of Deviation, and CV (Coefficient of Variation).		

Contagion/Interspersion Metrics:		
Type of Metric	Metric Abbrev.	Meaning
Class	CLUMPY	Clumpiness index
	PLADJ	Percentage of like adjacencies
	IJI	Interspersion and juxtaposition index
	DIVISION	Mass fractal dimension
	SPLIT	Splitting index
	MESH	Effective mesh size
	AI	Aggregation index
Landscape	CONTAG	Contagion
	PLADJ	Percentage of like adjacencies
	IJI	Interspersion and juxtaposition index
	IJI	Interspersion and juxtaposition index
	DIVISION	Mass fractal dimension
	SPLIT	Splitting index
	AI	Aggregation index

Connectivity Metrics:		
Type of Metric	Metric Abbrev.	Meaning
Class	COHESION	Patch cohesion index
Landscape	COHESION	Patch cohesion index

Diversity Metrics: (only computed for landscape)		
Type of Metric	Metric Abbrev.	Meaning
Landscape	PR	Patch richness
	PRD	Patch richness density
	SHDI	Shannon's diversity index
	SIDI	Simpson's diversity index
	MSDI	Modified Simpson's diversity index
	SHEI	Shannon's evenness index
	SIEI	Simpson's evenness index
	MSIEI	Modified Simpson's evenness index

Appendix B

Metrics for Combined Forest Classes

Area/Density/Edge Metrics (Class)						
TYPE	CA	PLAND	NP	PD	LPI	TE
Forest	101586.8891	62.207	1500	0.9185	53.9538	7305633
Shrub	22184.9843	13.585	8558	5.2405	0.683	7153158
Grass	26621.8187	16.3019	5776	3.5369	1.2784	6418770
Bare	2366.4904	1.4491	903	0.553	0.4197	969399
TYPE	ED	LSI				
Forest	44.7362	58.2937				
Shrub	43.8025	120.7753				
Grass	39.3055	99.4777				
Bare	5.9361	50.0439				
TYPE	AREA_MN	AREA_AM	AREA_MD	AREA_RA	AREA_SD	AREA_CV
Forest	67.7246	76516.852	0.731	88109.0624	2275.409	3359.7972
Shrub	2.5923	131.7867	0.6498	1115.3005	18.3006	705.9571
Grass	4.609	303.6116	0.6498	2087.645	37.123	805.4381
Bare	2.6207	216.6652	0.5686	685.3766	23.6843	903.7401
TYPE	GYRATE_MN	GYRATE_AM	GYRATE_MD	GYRATE_RA	GYRATE_SD	GYRATE_CV
Forest	78.4037	13795.7912	34.4214	15724.1857	426.1031	543.4731
Shrub	51.7893	436.3172	32.1639	2103.7405	71.1531	137.3896
Grass	60.7837	723.8848	34.183	3182.9672	100.7072	165.6814
Bare	56.1605	2119.637	29.7054	6546.436	250.1216	445.369

Area/Density/Edge Metrics (Landscape):					
TA	NP	PD	LPI		
163304.6495	17546	10.7443	53.9538		
TE	ED	LSI			
12861195	78.7558	81.4764			
AREA_MN	AREA_AM	AREA_MD	AREA_RA	AREA_SD	AREA_CV
9.3072	47834.4254	0.6498	88109.0624	667.1727	7168.3271
GYRATE_MN	GYRATE_AM	GYRATE_MD	GYRATE_RA	GYRATE_SD	GYRATE_CV
59.591	9226.1885	33.1092	18173.6018	213.8682	358.8936

Shape Metrics (Class):						
TYPE	SHAPE_MN	SHAPE_AM	SHAPE_MD	SHAPE_RA	SHAPE_SD	SHAPE_CV
Forest	1.3252	40.9076	1.1667	45.4856	1.2777	96.4196
Shrub	1.3324	3.875	1.1667	13.1787	0.5522	41.441
Grass	1.3759	4.5389	1.2	9.4308	0.6668	48.467
Bare	1.298	12.5447	1.1333	36.8696	1.3286	102.3598
TYPE	FRAC_MN	FRAC_AM	FRAC_MD	FRAC_RA	FRAC_SD	FRAC_CV
Forest	1.0515	1.3465	1.0472	0.3728	0.0418	3.9771
Shrub	1.0585	1.162	1.0478	0.3272	0.0497	4.6933
Grass	1.0605	1.1824	1.0478	0.3032	0.053	4.9967
Bare	1.0513	1.2106	1.0369	0.4619	0.0501	4.7644
TYPE	PARA_MN	PARA_AM	PARA_MD	PARA_RA	PARA_SD	PARA_CV
Forest	643.9541	73.1686	561.4035	1353.5373	362.1155	56.2331
Shrub	736.2503	324.5829	701.7544	1302.1222	360.0278	48.9002
Grass	708.012	243.8757	614.0351	1338.0078	368.2648	52.0139
Bare	746.3471	412.237	701.7544	1314.6503	357.9352	47.9583
TYPE	CIRCLE_MN	CIRCLE_AM	CIRCLE_MD	CIRCLE_RA	CIRCLE_SD	CIRCLE_CV
Forest	0.5179	0.7051	0.5103	0.6348	0.1232	23.7843
Shrub	0.5411	0.6769	0.5225	0.6882	0.1318	24.3663
Grass	0.5378	0.6892	0.52	0.7139	0.1343	24.9688
Bare	0.5181	0.7199	0.4907	0.7389	0.1368	26.4119
TYPE	CONTIG_MN	CONTIG_AM	CONTIG_MD	CONTIG_RA	CONTIG_SD	CONTIG_CV
Forest	0.5036	0.9419	0.55	0.9598	0.2589	51.4116
Shrub	0.4378	0.7446	0.4815	0.9178	0.2515	57.4562
Grass	0.459	0.808	0.5147	0.9483	0.2588	56.3963
Bare	0.4307	0.6799	0.4722	0.9283	0.2491	57.8487
TYPE	PAFRAC					
Forest	1.2994					
Shrub	1.3568					
Grass	1.3628					
Bare	1.3443					

Shape Metrics (Landscape):					
SHAPE_MN	SHAPE_AM	SHAPE_MD	SHAPE_RA	SHAPE_SD	SHAPE_CV
1.3559	29.5257	1.1667	120.4906	1.1882	87.6284
FRAC_MN	FRAC_AM	FRAC_MD	FRAC_RA	FRAC_SD	FRAC_CV
1.0583	1.292	1.0477	0.5596	0.0511	4.8307
PARA_MN	PARA_AM	PARA_MD	PARA_RA	PARA_SD	PARA_CV
714.6996	159.4077	614.0351	1353.5373	363.7983	50.9023
CIRCLE_MN	CIRCLE_AM	CIRCLE_MD	CIRCLE_RA	CIRCLE_SD	CIRCLE_CV
0.5365	0.7063	0.519	0.7864	0.1343	25.0392
CONTIG_MN	CONTIG_AM	CONTIG_MD	CONTIG_RA	CONTIG_SD	CONTIG_CV
0.4535	0.8749	0.5	0.9598	0.2553	56.2965
PAFRAC					
1.3565					

Core Area Metrics (Class):						
TYPE	TCA	CPLAND	NDCA	DCAD		
Forest	56788.54	34.7746	1216	0.7446		
Shrub	882.266	0.5403	688	0.4213		
Grass	3730.0957	2.2841	1004	0.6148		
Bare	193.478	0.1185	64	0.0392		
TYPE	CORE_MN	CORE_AM	CORE_RA	CORE_SD	CORE_CV	
Forest	37.859	45101.9663	51940.301	1341.3059	3542.8959	
Shrub	0.1031	15.3657	134.6711	2.2765	2208.1887	
Grass	0.6458	105.8693	976.8119	14.041	2174.232	
Bare	0.2143	11.9373	46.3795	2.4089	1124.2669	
TYPE	DCORE_MN	DCORE_AM	DCORE_MD	DCORE_RA	DCORE_SD	DCORE_CV
Forest	46.7011	1253.9712	1.3808	3922.0304	237.4465	508.4388
Shrub	1.2824	6.6666	0.4061	29.8908	2.6276	204.906
Grass	3.7152	136.0326	0.5686	634.1236	22.1718	596.7814
Bare	3.0231	22.2776	0.8935	45.9734	7.6294	252.3716
TYPE	CAI_MN	CAI_AM	CAI_RA	CAI_SD	CAI_CV	
Forest	1.6206	55.9014	67.0852	6.7467	416.3037	
Shrub	0.1729	3.9769	42.2096	1.3258	766.8037	
Grass	0.6171	14.0114	56.4145	3.3476	542.5044	
Bare	0.4398	8.1757	48.9311	3.2847	746.8149	

Core Area Metrics (Landscape):					
TCA	NDCA	DCAD			
64388.9257	3186	1.951			
CORE_MN	CORE_AM	CORE_RA	CORE_SD	CORE_CV	
3.6697	28133.4582	51940.301	392.7422	10702.2347	
DCORE_MN	DCORE_AM	DCORE_MD	DCORE_RA	DCORE_SD	
20.21	1119.8193	0.731	3922.0304	149.074	737.6265
CAI_MN	CAI_AM	CAI_RA	CAI_SD	CAI_CV	
0.4849	39.4287	67.0852	3.1678	653.3328	

Isolation/Proximity Metrics (Class):						
TYPE	PROX_MN	PROX_AM	PROX_MD	PROX_RA	PROX_SD	PROX_CV
Forest	48452.9323	21703.9941	1	272610.0083	91357.1091	188.5482
Shrub	31.0966	168.3704	0.2222	3435.75	215.3132	692.4
Grass	57.0705	193.4128	0.2	6425.75	330.7305	579.5126
Bare	41.0467	81.6253	0	2109.75	260.2676	634.0771
TYPE	ENN_MN	ENN_AM	ENN_RA	ENN_SD	ENN_CV	
Forest	108.9085	58.9617	636.4349	67.1412	61.6492	
Shrub	115.5646	82.2022	883.9317	75.8067	65.5969	
Grass	123.0736	78.6646	1657.7434	93.2583	75.7744	
Bare	341.3309	176.2998	2836.6975	402.02	117.7801	

Isolation/Proximity Metrics (Landscape):					
PROX_MN	PROX_AM	PROX_RA	PROX_SD	PROX_CV	
4193.257	13564.987	272610.0083	29947.4657	714.1815	
ENN_MN	ENN_AM	ENN_MD	ENN_RA	ENN_SD	ENN_CV
143.1827	71.1513	102.7582	4101.3639	175.7531	122.7475

Contagion/Interspersion Metrics (Class):				
TYPE	CLUMPY	PLADJ	IJI	COHESION
Forest	0.8643	94.7867	70.9435	99.9431
Shrub	0.7341	76.8735	59.1309	94.1698
Grass	0.7941	82.6239	67.6406	96.2706
Bare	0.7062	70.6281	75.6051	97.7374
TYPE	DIVISION	MESH	SPLIT	AI
Forest	0.7085	47598.8221	3.4309	94.8716
Shrub	0.9999	17.9033	9121.5059	77.0209
Grass	0.9997	49.4946	3299.4458	82.7684
Bare	1	3.1398	52011.9565	71.0451

Contagion/Interspersion Metrics (Landscape):			
CONTAG	PLADJ	IJI	COHESION
58.5698	88.6422	68.8838	99.686
DIVISION	MESH	SPLIT	AI
0.7071	47834.4254	3.414	88.7666

Landscape Diversity Metrics:				
PR	PRD	SHDI	SIDI	MSIDI
7	0.0043	1.1673	0.5662	0.8352
SHEI	SIEI	MSIEI		
0.5999	0.6606	0.4292		

Appendix C

Metrics for Separate Evergreen/Hardwood Forest Classes

Area/Density/Edge Metrics (Class):						
TYPE	CA	PLAND	NP	PD	LPI	TE
Hardwood	58934.5857	36.0887	3218	1.9706	8.8783	8327158.5
Shrub	22184.9843	13.585	8558	5.2405	0.683	7153158
Evergreen	42652.3034	26.1182	4421	2.7072	1.4598	7266103.5
Grass	26621.8187	16.3019	5776	3.5369	1.2784	6418770
Bare	2366.4904	1.4491	903	0.553	0.4197	969399
TYPE	ED	LSI	NLSI			
Hardwood	50.9916	86.4208	0.1004			
Shrub	43.8025	120.7753	0.2298			
Evergreen	44.4942	88.6476	0.1212			
Grass	39.3055	99.4777	0.1723			
Bare	5.9361	50.0439	0.2895			
TYPE	AREA_MN	AREA_AM	AREA_MD	AREA_RA	AREA_SD	AREA_CV
Hardwood	18.314	5025.933	0.8935	14498.5813	302.8362	1653.5736
Shrub	2.5923	131.7867	0.6498	1115.3005	18.3006	705.9571
Evergreen	9.6477	524.2168	0.9747	2383.7913	70.4584	730.3161
Grass	4.609	303.6116	0.6498	2087.645	37.123	805.4381
Bare	2.6207	216.6652	0.5686	685.3766	23.6843	903.7401
TYPE	GYRATE_MN	GYRATE_AM	GYRATE_MD	GYRATE_RA	GYRATE_SD	GYRATE_CV
Hardwood	84.9048	3619.0613	37.8036	7232.3359	258.9959	305.0428
Shrub	51.7893	436.3172	32.1639	2103.7405	71.1531	137.3896
Evergreen	79.8109	905.5012	40.3462	2518.166	138.1696	173.1211
Grass	60.7837	723.8848	34.183	3182.9672	100.7072	165.6814
Bare	56.1605	2119.637	29.7054	6546.436	250.1216	445.369

Area/Density/Edge Metrics (Landscape):					
TA	NP	PD	LPI		
163304.6495	23685	14.5036	8.8783		
TE	ED	LSI			
17005009.5	104.1306	107.1105			
AREA_MN	AREA_AM	AREA_MD	AREA_RA	AREA_SD	AREA_CV
6.8949	2186.3153	0.731	14498.5813	122.5838	1777.9025
GYRATE_MN	GYRATE_AM	GYRATE_MD	GYRATE_RA	GYRATE_SD	GYRATE_CV
65.6131	2186.818	34.4214	18173.6018	187.5299	285.8118

Shape Metrics (Class):						
TYPE	SHAPE_MN	SHAPE_AM	SHAPE_MD	SHAPE_RA	SHAPE_SD	SHAPE_CV
Hardwood	1.3967	15.0637	1.2	29.4225	1.0636	76.1488
Shrub	1.3324	3.875	1.1667	13.1787	0.5522	41.441
Evergreen	1.3849	5.3288	1.2	14.203	0.7118	51.3998
Grass	1.3759	4.5389	1.2	9.4308	0.6668	48.467
Bare	1.298	12.5447	1.1333	36.8696	1.3286	102.3598
TYPE	FRAC_MN	FRAC_AM	FRAC_MD	FRAC_RA	FRAC_SD	FRAC_CV
Hardwood	1.0567	1.2753	1.0477	0.3635	0.0476	4.5021
Shrub	1.0585	1.162	1.0478	0.3272	0.0497	4.6933
Evergreen	1.0587	1.1898	1.0478	0.3219	0.0462	4.3627
Grass	1.0605	1.1824	1.0478	0.3032	0.053	4.9967
Bare	1.0513	1.2106	1.0369	0.4619	0.0501	4.7644
TYPE	PARA_MN	PARA_AM	PARA_MD	PARA_RA	PARA_SD	PARA_CV
Hardwood	617.9084	142.427	526.3158	1313.8592	353.1709	57.1559
Shrub	736.2503	324.5829	701.7544	1302.1222	360.0278	48.9002
Evergreen	597.4589	171.7779	514.6199	1330.4368	348.5839	58.3444
Grass	708.012	243.8757	614.0351	1338.0078	368.2648	52.0139
Bare	746.3471	412.237	701.7544	1314.6503	357.9352	47.9583
TYPE	CIRCLE_MN	CIRCLE_AM	CIRCLE_MD	CIRCLE_RA	CIRCLE_SD	CIRCLE_CV
Hardwood	0.5319	0.7584	0.5132	0.6766	0.1327	24.9476
Shrub	0.5411	0.6769	0.5225	0.6882	0.1318	24.3663
Evergreen	0.5313	0.6698	0.5162	0.6587	0.1245	23.4355
Grass	0.5378	0.6892	0.52	0.7139	0.1343	24.9688
Bare	0.5181	0.7199	0.4907	0.7389	0.1368	26.4119
TYPE	CONTIG_MN	CONTIG_AM	CONTIG_MD	CONTIG_RA	CONTIG_SD	CONTIG_CV
Hardwood	0.5225	0.8868	0.5741	0.9282	0.2537	48.5619
Shrub	0.4378	0.7446	0.4815	0.9178	0.2515	57.4562
Evergreen	0.5374	0.8637	0.5917	0.9382	0.2531	47.1037
Grass	0.459	0.808	0.5147	0.9483	0.2588	56.3963
Bare	0.4307	0.6799	0.4722	0.9283	0.2491	57.8487
TYPE	PAFRAC					
Hardwood	1.3515					
Shrub	1.3568					
Evergreen	1.3244					
Grass	1.3628					
Bare	1.3443					

Shape Metrics (Landscape):					
SHAPE_MN	SHAPE_AM	SHAPE_MD	SHAPE_RA	SHAPE_SD	SHAPE_CV
1.3688	10.9064	1.1875	120.4906	1.0913	79.7236
FRAC_MN	FRAC_AM	FRAC_MD	FRAC_RA	FRAC_SD	FRAC_CV
1.0586	1.2254	1.0477	0.5596	0.0503	4.7501
PARA_MN	PARA_AM	PARA_MD	PARA_RA	PARA_SD	PARA_CV
684.1453	210.1572	601.5038	1338.0078	363.2579	53.0966
CIRCLE_MN	CIRCLE_AM	CIRCLE_MD	CIRCLE_RA	CIRCLE_SD	CIRCLE_CV
0.5361	0.7163	0.519	0.7864	0.133	24.8031
CONTIG_MN	CONTIG_AM	CONTIG_MD	CONTIG_RA	CONTIG_SD	CONTIG_CV
0.4754	0.8346	0.5238	0.9483	0.2571	54.0728
PAFRAC					
1.3486					

Core Area Metrics (Class):						
TYPE	TCA	CPLAND	NDCA	DCAD		
Hardwood	16853.1316	10.3201	1981	1.2131		
Shrub	882.266	0.5403	688	0.4213		
Evergreen	9811.249	6.0079	1724	1.0557		
Grass	3730.0957	2.2841	1004	0.6148		
Bare	193.478	0.1185	64	0.0392		
TYPE	CORE_MN	CORE_AM	CORE_RA	CORE_SD	CORE_CV	
Hardwood	5.2371	1898.5195	5603.5503	114.905	2194.0399	
Shrub	0.1031	15.3657	134.6711	2.2765	2208.1887	
Evergreen	2.2192	182.2164	1139.7492	25.8174	1163.3456	
Grass	0.6458	105.8693	976.8119	14.041	2174.232	
Bare	0.2143	11.9373	46.3795	2.4089	1124.2669	
TYPE	DCORE_MN	DCORE_AM	DCORE_MD	DCORE_RA	DCORE_SD	DCORE_CV
Hardwood	8.5074	278.1295	0.8123	1596.8835	47.8934	562.9628
Shrub	1.2824	6.6666	0.4061	29.8908	2.6276	204.906
Evergreen	5.691	81.1203	0.8123	463.6323	20.7188	364.063
Grass	3.7152	136.0326	0.5686	634.1236	22.1718	596.7814
Bare	3.0231	22.2776	0.8935	45.9734	7.6294	252.3716
TYPE	CAI_MN	CAI_AM	CAI_RA	CAI_SD	CAI_CV	
Hardwood	1.2311	28.5963	46.5465	4.8733	395.8394	
Shrub	0.1729	3.9769	42.2096	1.3258	766.8037	
Evergreen	1.7749	23.0029	51.5666	6.1867	348.5722	
Grass	0.6171	14.0114	56.4145	3.3476	542.5044	
Bare	0.4398	8.1757	48.9311	3.2847	746.8149	

Core Area Metrics (Landscape):					
TCA	NDCA	DCAD			
34264.7663	5675	3.4751			
CORE_MN	CORE_AM	CORE_RA	CORE_SD	CORE_CV	
1.4467	809.6309	5603.5503	46.5561	3218.119	
DCORE_MN	DCORE_AM	DCORE_MD	DCORE_RA	DCORE_SD	DCORE_CV
6.0378	186.0808	0.6498	1596.8835	32.9708	546.0685
CAI_MN	CAI_AM	CAI_RA	CAI_SD	CAI_CV	
0.7551	20.9821	56.4145	3.8928	515.5205	

Isolation/Proximity Metrics (Class):						
TYPE	PROX_MN	PROX_AM	PROX_MD	PROX_RA	PROX_SD	PROX_CV
Hardwood	1960.6555	5232.4409	0.1111	44638	6618.6552	337.5736
Shrub	31.0966	168.3704	0.2222	3435.75	215.3132	692.4
Evergreen	155.3714	221.3749	0	7339.9583	677.4459	436.0173
Grass	57.0705	193.4128	0.2	6425.75	330.7305	579.5126
Bare	41.0467	81.6253	0	2109.75	260.2676	634.0771
TYPE	ENN_MN	ENN_AM	ENN_MD	ENN_RA	ENN_SD	ENN_CV
Hardwood	116.3301	64.0715	90.1249	862.9807	75.0057	64.4766
Shrub	115.5646	82.2022	90.1249	883.9317	75.8067	65.5969
Evergreen	126.1054	74.1212	102.7582	885.2257	87.3924	69.3011
Grass	123.0736	78.6646	90.1249	1657.7434	93.2583	75.7744
Bare	341.3309	176.2998	182.489	2836.6975	402.02	117.7801

Isolation/Proximity Metrics (Landscape):					
PROX_MN	PROX_AM	PROX_RA	PROX_SD	PROX_CV	
333.1972	2009.729	44638	2572.9392	772.1971	
ENN_MN	ENN_AM	ENN_MD	ENN_RA	ENN_SD	ENN_CV
138.5173	76.9547	102.7582	4101.3639	157.6185	113.7897

Contagion/Interspersion Metrics (Class):				
TYPE	CLUMPY	PLADJ	IJI	COHESION
Hardwood	0.8429	89.8521	66.3983	99.3973
Shrub	0.7341	76.8735	71.5395	94.1698
Evergreen	0.836	87.7608	64.2375	97.7836
Grass	0.7941	82.6239	73.1734	96.2706
Bare	0.7062	70.6281	79.8549	97.7374
TYPE	DIVISION	MESH	SPLIT	AI
Hardwood	0.9889	1813.7958	90.0348	89.9577
Shrub	0.9999	17.9033	9121.5059	77.0209
Evergreen	0.9992	136.9162	1192.7342	87.8822
Grass	0.9997	49.4946	3299.4458	82.7684
Bare	1	3.1398	52011.9565	71.0451

Contagion/Interspersion Metrics (Landscape):			
CONTAG	PLADJ	IJI	COHESION
47.3091	85.0263	72.7453	98.7003
DIVISION	MESH	SPLIT	AI
0.9866	2186.3153	74.694	85.1677

Landscape Diversity Metrics:				
PR	PRD	SHDI	SIDI	MSIDI
8	0.0049	1.5905	0.7547	1.4054
SHEI	SIEI	MSIEI		
0.7649	0.8626	0.6759		